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Economic Returns From Indiana Demonstration Woodlands

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ECONOMIC RETURNS FROM INDIANA DEMONSTRATION WOODLANDS

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Introduction

In 1947, Indiana Extension foresters initiated a demonstration woods project in cooperation with selected private forest landowners. The primary objectives of the project were to obtain economic records of costs and returns from the woodland enterprise and to establish demonstrations of good woodland management. The woodland owners agreed to protect their forests from fire and livestock and to keep records of costs, yields and incomes. In return, Extension foresters assisted each owner by providing technical management assistance and in summarizing woodland account records.

Records for 50 demonstration woods were reported (Callahan, 1966). During that initial period covering an average of 12.5 years the net dollar returns averaged about $7 per acre annually, and the average return on all investment costs (internal rate of return) was 5 per cent. Values were converted to relative 1957-1959 dollars.

The present summary includes records from 21 of the original woodlands for a period averaging 11.5 years ending in 1972.

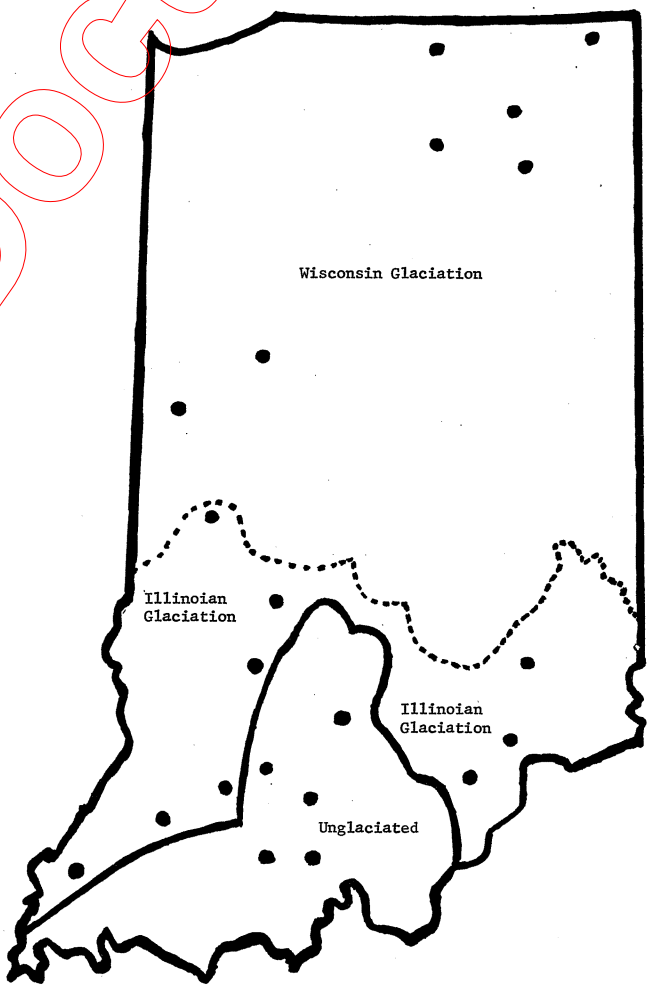

Figure 1. Location of twenty-one demonstration woods.

* In cooperation with Indiana Extension foresters E. J. Lott, A. N. Liming, F. T. Miller and R. W. Wenger. Nacker is now employed by the State of Wisconsin.

Figure 2. This mixed-hardwood stand averaged 6,000 board feet per acre during the period with an annual net growth of 231 board feet per acre.

During this time the 21 woodlands averaged an annual net dollar return of more than $18 an acre and an internal rate of return of 5.7 per cent (measured in 1970-72 dollars).

The 21 woodlands selected for this summary are largely concentrated in the more wooded portions of northeastern and southern Indiana (Figure 1). The tracts range from 10 to 80 acres, but most are near the average of 33 acres. Ten are classed as oak-hickory, seven as mixed-hardwoods and four as beech-maple cover types. Farmers own 15 of the woodlands, five are owned by business and professional people, and one is owned by a wood-using industry.

Demonstration woodlands have somewhat higher stocking levels than the average Indiana woodland. Sawtimber volumes averaged 4.8 thousand board feet (M bd. ft.) per acre; however, there were wide differences in woodlands as stocking levels ranged from 2.0 to 8.4 M bd. ft.* Only two of the woodlands had stocking levels below the state average of about 2.8 M bd. ft. Estimated annual timber growth potential is more than 200 board feet per acre in all of the woodlands.

Management objectives of demonstration woods owners include timber production, wildlife conservation, family recreation and aesthetics. However, the weight given to each varies among the owners. The individual-tree selection system of cutting is used in the beech-maple types, and group selection predominates in the mixed-hardwoods and oak-hickory types. Most owners market their timber as standing trees (stumpage), although farmers occasionally have low grade trees cut into lumber, firewood or other products for home-use. All but three owners harvested timber during the period.

Woodland Incomes

Incomes received by owners were derived from the sale and home use of timber products (Table 1). Although other woodland values are recognized (maple syrup, recreation, wildlife, etc.), incomes from sources

* All board foot volumes are given in Doyle Scale.

Table 1. Average annual harvest per acre for 21 demonstration woodlands by type of product and state region

Product	Unit of measure	7 northern Indiana woodlands				14 southern Indiana woodlands				21 Indiana woodlands			
		Sales		Home use		Sales		Home use		Sales		Home use	
		Volume	Dollars	Volume	Dollars	Volume	Dollars	Volume	Dollars	Volume	Dollars	Volume	Dollars
Stumpage	bd. ft. [1]	61	5.51	--	--	83	3.28	--	--	76	4.03	--	--
Logs	bd. ft.	11	0.70	--	--	31	2.57	--	--	25	1.94	--	--
Lumber	bd. ft.	--	--	26	1.76	2	0.16	9	0.57	1	0.11	15	0.97
Fuelwood [2]	ricks [3]	(.15)	0.93	(.10)	0.79	--	--	(.12)	0.71	(.05)	0.31	(.12)	0.74
Posts, poles	pieces	--	--	(.30)	0.09	--	--	(.37)	0.10	--	--	(.35)	0.09
Totals	dollars		7.14		2.64		6.01		1.38		6.39		1.80
	bd. ft.	72		26		116		9		102		15	

1/ Doyle scale.

2/ Fuelwood and post and pole volumes not included in board foot summaries.

3/ A stack of fuelwood or other material of a width equal to the length of the pieces, 4 feet high x 8 feet long.

Figure 3. By harvesting timber at frequent intervals, owners are able to market crop trees at their peak value.

other than timber were excluded. Total incomes from timber sales and home use averaged a little more than $8 an acre annually.

Cash sales include stumpage, logs, lumber, and fuelwood. Stumpage sales were the major source of cash incomes averaging $4.03 per acre annually. Small volume sales of logs, lumber and fuelwood increased total annual sales to $6.39 per acre. Southern Indiana woodlands had a higher average volume of products sold than northern Indiana, but northern woodlands had a slightly higher dollar income on the average.

Home-use incomes derived largely from lumber and fuelwood averaged $1.80 per acre annually. Ten of the 21 owners cut both lumber and fuelwood, while only two owners harvested posts or poles for home use.

Owners harvested an average annual volume of 117 board feet of sawtimber per acre. Of this total, 76 board feet were sold as stumpage, 25 board feet sold as logs and 16 board feet were sawed into lumber. Fuelwood volumes averaged .17 rick per acre annually.

Woodland Expenses

Annual woodland expenses averaged $2.21 per acre for the 21 woodlands (Table 2). Non-cash harvesting costs including labor and equipment amounted to $1.51 per acre. Cash harvesting expenses averaged $0.42 per acre. These expenses include contracted logging and milling, fuel, repairs and small tools. General operating expenses, which include fire prevention, fencing, taxes and administrative fees, averaged $0.20 per acre. Taxes were reduced by wide participation in the Indiana Classified Forest Act.* Improvement costs of tree planting and the control of cull trees and vines averaged $0.08 per acre annually, ranging from 3 to 45 cents for the 21 woodlands. Annual woodland expenses averaged $2.48 per acre for northern Indiana woodlands and $2.09 for southern woodlands. The difference was largely because of higher harvesting expenses in northern Indiana.

* Qualified forest land and timber is currently assessed at $1 an acre. Local tax rates are used in determining tax liabilities.

Table 2. Average annual woodland expenses per acre for 21 demonstration woodlands by state regions

Woodland expenses	7 northern Indiana woodlands	14 southern Indiana woodlands	21 Indiana woodlands
		- - - - - - dollars - - - - - -	
Non-cash harvesting	1.79	1.38	1.51
Cash harvesting	0.46	0.40	0.42
Improvement expenses	0.06	0.10	0.08
General operating expenses	0.17	0.21	0.20
Total	2.48	2.09	2.21
Average timber capital investments per acre [1]	442.59	305.49	351.19

1/ An average of estimated beginning and ending timber capital investments for the period.

Timber Investment Value and Inventory Change

Permanent one-fifth acre sample plots were established in each of the woodlands for inventory purposes and are remeasured at about 5-year intervals. Cutting and other work is done on the plots as if they were not there. The timber capital investment (value of merchantable trees) was determined for each woodland at the beginning and ending inventory. Dollar values of sawtimber were calculated using tree quality indices developed by Herrick (1956). The tree quality index (Q.I.) expresses the value of the lumber in a tree as the percentage of the value of an equal volume of No. 1 common lumber. The tree volume, grade, and lumber price are then used to convert QI's to dollars. This tree product value was reduced by logging and milling costs to obtain the "conversion value" or stumpage value plus margin for profit and risk for both owner and purchaser. Pulpwood values were

Table 3. Distribution of average sawtimber volume stocking levels and annual net growth for 21 demonstration woodlands

Volume per acre [1]		Number of woodlands	Annual net growth per acre [2]
Group range	Group average		
M board feet			board feet
2.0 - 3.9	2.9	6	115
4.0 - 5.9	4.7	10	161
6.0 - 7.9	6.8	4	233
8.0 - 9.9	8.4	1	236

1/ An average of beginning and ending volumes of trees over 11.0 inches (diameter breast high) for the period.

2/ Net growth includes ingrowth and takes into account harvest and volume loss caused by mortality.

Table 4. Summary of average annual costs and returns per acre for 21 demonstration woodlands by state regions

Income	7 northern Indiana woodlands	14 southern Indiana woodlands	21 Indiana woodlands
		- - - - - - dollars - - - - - -	
Cash sales	7.14	6.01	6.39
Home use	2.64	1.38	1.80
Inventory value changes	17.69	9.93	12.51
Totals	$27.47	$17.32	$20.70
Operating costs	-2.48	-2.09	-2.21
Net return	$24.99	$15.23	$18.49

obtained by applying the stumpage value of 50 cents per ton to pulpwood volumes of trees 9.6 inches DBH* and larger. The sawtimber and pulpwood values were combined to give the total timber capital investment. Prices current at the ending inventory were used to compute both beginning and ending inventory values. The timber capital investment for the period averaged $351 per acre and ranged between $90 and $674 for the 21 woodlands. Woodlands in nothern Indiana averaged about $443 and in southern Indiana $305 per acre. Land values were not included.

The average annual timber inventory value change per acre was determined by the increase or decrease in timber capital between the beginning and ending inventories. The increase or decrease resulted from changes in timber volume and tree grade. During the period, four woodlands decreased in timber capital largely because the volume harvested exceeded timber growth. For all woodlands, the annual inventory change increased an average of $12.51 per acre. Northern Indiana woodlands increased $17.69 and southern woodlands increased $9.93 per acre annually.

* Diameter breast high (4 1/2 feet above the ground).

Stocking levels ranged from 2.0 to 8.4 M bd. ft. per acre with an average of 4.8 for all woodlands (Table 3). Ten woodlands had stocking levels between 4.0 and 5.9 M bd. ft. per acre. Net growth ranged from 36 to 281 board feet per acre with seven woodlands averaging more than 220 board feet per acre per year. When grouped by stocking levels, average net growth increased with sawtimber volumes.

Table 5. Frequency distribution of net dollar returns per acre for 21 demonstration woodlands

Annual returns per acre	Number
dollars	
0 - 5.00	1
5.01 - 10.00	3
10.01 - 15.00	6
15.01 - 20.00	3
20.01 - 25.00	3
25.01 - 30.00	1
30.01 - 35.00	2
35.01 - 40.00	2
Totals	21

Average annual net returns per acre $18.49

Net Dollar Returns

Average annual net dollar returns for the period included income from sales and home use of timber products plus the timber inventory value change minus woodland expenses. This residual represents the net return to capital and management.

For the 21 woodlands, the annual net dollar return averaged $18.49 per acre (Table 4). The seven northern Indiana woodlands had an average net return of $25 per acre (about $10 per acre more than those in southern Indiana); however, individual returns varied from $3 to $40 an acre. Eight woodlands earned more than $20 while four averaged less than $10 per acre annually (Table 5).

Internal Rates of Return

The internal rate of return is commonly used in comparing alternative investments. In a timber-growing enterprise, the internal rate of return may be defined as the average rate of interest earned on all costs incurred prior to the time of harvest. A more formal definition is that it is the compound interest rate that will make the discounted value of net revenues (including standing timber values at the end of the inventory period) equal to the discounted costs incurred in growing the trees.

Table 6. Frequency distribution of average net rates of return on timber investments for 21 demonstration woodlands

Rates of return	Number
per cent	
0 - 2.0	1
2.1 - 4.0	5
4.1 - 6.0	5
6.1 - 8.0	8
8.1 - 10.0	2
Totals	21

Average rate of return 5.7%

Internal rates of return ranged from 2.0 per cent to 9.8 per cent for the 21 woodlands averaging 5.7 per cent for the period. Ten of the woodlands earned rates above 6 per cent while 6 earned rates of less than 4 per cent (Table 6).

Figure 4. Tulip poplar reproduction in a woods opening 10 years after a periodic harvest cut.

Table 7. Average annual returns per acre and internal rates of return for 21 demonstration woodlands by level of investment in timber capital

Investment level		Number of woodlands	Internal rate of return	Annual returns per acre
Group range	Group average			
dollars per acre			percent	dollars
< 200	134	4	6.4	$ 8.43
200 - 399	311	10	6.0	$17.69
400 >	534	7	4.9	$25.36

Some Relationships of Rate of Return and Net Dollar Returns to Level of Investments, Soils and Forest Types

Rates of return and net dollar returns for the 21 woodlands were grouped by investment levels, broad soil groups and forest types. As shown in Table 7, rates of return decreased as investment levels increased. These relationships are typical of most forestry investment analyses.

Internal rates of return and net dollar return were compared among three broad soil groupings (Table 8). Seven woodlands are in Wisconsin glacial soils, nine are in the Illinoian glacial soils and five are in the unglaciated area. Woodlands in the Wisconsin glacial soils averaged the highest timber investment and net dollar return per acre, while those in the Illinoian glacial soils ranked second.

The 21 woodlands represent three major Indiana forest cover types -- beech-maple, oak-hickory and mixed-hardwoods. When grouped by forest types (Table 9), the beech-maple type averaged the highest timber capital investment and net dollar return followed by the mixed-hardwood type. The highest rate of return was earned by the oak-hickory type, while rates for beech-maple and mixed-hardwoods were nearly equal. Average sawtimber growing stock volumes were highest for the beech-maple type.

Effects of Management on Internal Rates of Return and Net Dollar Returns

Summaries of demonstration woods records show that the highest internal rate of return and highest net dollar return might not occur simultaneously. Net dollar returns tend to be closely and positively related to stocking level, average tree size, and the quality and species composition of the growing stock. The reverse is true of the rate of return. High rates of return are associated with lower stocking levels,

Table 8. Average annual returns per acre and internal rates of return for 21 demonstration woodlands by broad soil groupings

Soil groups	Number of woodlands	Average investment per acre	Internal rate of return	Annual returns per acre
		dollars	percent	dollars
Unglaciated soils	5	284	5.8	$12.15
Illinoian glacial soils	9	318	5.7	$16.94
Wisconsin glacial soils	7	443	5.7	$24.99

Table 9. Average annual returns per acre and internal rates of return for 21 demonstration woodlands by forest cover type

Forest cover type	Number of woodlands	Average investment per acre	Internal rate of return	Annual returns per acre
		dollars	per cent	dollars
Oak-Hickory	10	282	6.1	$16.60
Beech-Maple	4	519	5.3	$26.88
Mixed Hardwoods	7	354	5.4	$16.38

smaller tree size, lower quality trees and lower value species. Woodlands having high stocking levels of large nearly mature trees characteristically have higher timber capital investments and net dollar returns but low to moderate internal rates of return. Other woodlands having vigorous immature sawtimber stands have a lower timber capital investment and dollar return but an above average rate of return.

Maximization of rate of return might not be economically justified. Where rates of return are higher than available from alternative investments, an increase in stocking level or other improvements might be appropriate to increase dollar returns or to satisfy other ownership objectives. Theoretically an owner should strive for an "optimum" timber capital investment which earns a rate of return comparable to alternative investment opportunities. The timber capital can be reduced by thinnings which lowers the investment in standing trees and increases the rate of value production. Part of the increase comes from accelerated growth in volume and value of desirable trees and part from the removal of trees making poor growth. The adjustment of growing stock should be coordinated with fluctuations of timber markets.

Figure 5. Demonstration woods provide timber owners an opportunity to inspect and discuss forest management practices.

Information and assistance in timber management is available from a number of public and private professional foresters. To seek assistance obtain the name of the nearest service forester of the Indiana Division of Forestry and other information by contacting the Cooperative Extension Service office in your county, or write to the Extension forester, Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907.

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